

**CHATLIN LAKE CANAL/BAYOU DU LAC
AND BAYOU DES GLAISES
DIVERSION CHANNEL TMDLS FOR
DISSOLVED OXYGEN AND NUTRIENTS**

April 19, 2002

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SUBSEGMENTS 060212 AND 060207

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EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify waterbodies that are not meeting water quality standards and to develop total maximum daily pollutant loads for those waterbodies. A total maximum daily load (TMDL) is the amount of pollutant that a waterbody can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be distributed or allocated to point sources and nonpoint sources discharging to the waterbody. This report presents TMDLs that have been developed for dissolved oxygen (DO) and nutrients for 2 subsegments in the Vermilion-Teche basin in southern Louisiana.

The subsegments for which TMDLs were developed are:

060212 – Chatlin Lake Canal/Bayou du Lac

060207 – Bayou des Glaises Diversion Channel

These two subsegments drain approximately 530 km² between the Red River, Bayou Boeuf, and the West Atchafalaya Basin Protection Levee. Water in the study area comes primarily from local runoff. The lower end of subsegment 060207 receives water diverted from the Atchafalaya River as part of the US Army corps of Engineers Teche-Vermilion Basin water control project. There are several source dischargers in the study and land use is primarily agricultural.

Both of these subsegments were listed on the Modified Court Ordered 303(d) List for Louisiana as not fully supporting the designated use of propagation of fish and wildlife and were ranked as priority #1 for TMDL development. Neither of these subsegments was included on the 1998 303(d) List, but both were later added to the list based on LDEQ assessment data collected during June through December 1998. The causes for impairment cited in the 303(d) List included organic enrichment/low DO for both subsegments and nutrients for one of the subsegments (Bayou des Glaises Diversion Channel). The water quality standard for DO is 5 mg/L year round for both subsegments.

A water quality model (LA-QUAL) was set up to simulate DO, CBOD, ammonia nitrogen, and organic nitrogen in both subsegments. The model was calibrated using LDEQ assessment data collected during June through December 1998, data from FTN's synoptic survey in September 2000, and other information obtained from LDEQ, Corps of Engineers, and USGS. There were no intensive survey data available for the primary waterbodies in these subsegments. The projection simulation was run at critical flows and temperatures to address seasonality as required by the Clean Water Act. Reductions of existing loads from both point sources and nonpoint sources were required for the projection simulation to show the DO standard of 5 mg/L being maintained. In general, the modeling in this study was consistent with guidance in the Louisiana TMDL Technical Procedures Manual.

TMDLs for oxygen demanding substances (CBOD, ammonia nitrogen, organic nitrogen, and sediment oxygen demand) were calculated using the results of the projection simulation. Both implicit and explicit margins of safety were included in the TMDL calculations. The nutrient TMDLs were developed based on Louisiana's water quality standard for nutrients, which states that "the naturally occurring range of nitrogen to phosphorus ratios shall be maintained". The nutrient TMDLs were calculated using allowable nitrogen loadings from the projection simulation and applying a naturally occurring nitrogen to phosphorus ratio to determine the allowable phosphorus loadings.

The TMDLs for these subsegments include wasteload allocations for 6 specific point source discharges plus an additional wasteload allocation for all of the other point sources with minor oxygen demanding discharges within the subsegments. A treatment upgrade will be required. Average nonpoint source reductions of 47% to 58% are required for the subsegments to meet the water quality standard for DO.

TABLE OF CONTENTS

1.0	INTRODUCTION.....	1-1
2.0	STUDY AREA DESCRIPTION	2-1
2.1	General Information.....	2-1
2.2	Water Quality Standards	2-2
2.3	Identification of Sources	2-2
2.3.1	Point Sources	2-2
2.3.2	Nonpoint Sources.....	2-3
2.4	Previous Data and Studies	2-3
3.0	CALIBRATION OF WATER QUALITY MODEL.....	3-1
3.1	Model Setup.....	3-1
3.2	Calibration Period	3-2
3.3	Temperature Correction of Kinetics (Data Type 4)	3-2
3.4	Hydraulics (Data Type 9).....	3-3
3.5	Initial Conditions (Data Type 11)	3-3
3.6	Water Quality Kinetics (Data Types 12 and 13).....	3-4
3.7	Nonpoint Source Loads (Data Type 19)	3-4
3.8	Headwater and Tributary Flow Rates (Data Types 20 and 24).....	3-5
3.9	Headwater and Tributary Water Quality (Data Types 21 and 25)	3-5
3.10	Point Source Inputs (Data Types 24 and 25)	3-6
3.11	Calibration Methodology	3-6
3.12	Model Results for Calibration.....	3-7
4.0	WATER QUALITY MODEL PROJECTION.....	4-1
4.1	Identification of Critical Conditions	4-1
4.2	Temperature Inputs	4-2
4.3	Headwater and Tributary Inputs.....	4-3
4.4	Point Source Inputs	4-4
4.5	Nonpoint Source Loads.....	4-4

TABLE OF CONTENTS (CONTINUED)

4.6	Other Inputs.....	4-5
4.7	Model Results for Projection	4-5
5.0	WATER QUALITY MODEL PROJECTION.....	5-1
5.1	Calculated DO TMDL, WLAs and LAs	5-1
5.2	Calculated Nutrient TMDL, WLAs and LAs.....	5-2
5.3	Summary of NPS Reductions and Point Source Upgrades.....	5-2
5.4	Seasonal Variation	5-3
5.5	Margin of Safety	5-3
6.0	SENSITIVITY ANALYSES.....	6-1
7.0	CONCLUSIONS.....	7-1
8.0	REFERENCES	8-1

LIST OF APPENDICES

APPENDIX A:	Map of Study Area
APPENDIX B:	Minor Point Source Discharges in the Study Area
APPENDIX C:	Vector Diagram for Water Quality Model
APPENDIX D:	LDEQ Water Quality Data and USGS Flow Data
APPENDIX E:	Model Input Data and Sources for Calibration
APPENDIX F:	Plots of Predicted and Observed Water Quality
APPENDIX G:	Printout of Model Output for Calibration
APPENDIX H:	Model Input Data and Sources for Projection
APPENDIX I:	Plots of Predicted Water Quality for Projection
APPENDIX J:	Printout of Model Output for Projection
APPENDIX K:	TMDL Calculations
APPENDIX L:	Responses to Comments

LIST OF TABLES

Table 1.1	Summary of 303(d) Listing of the 2 subsegments in the study area	1-2
Table 2.1	Land uses in the study area based on GAP data.....	2-1
Table 2.2	Water quality standards and designated uses	2-2
Table 2.3	Relevant information for discharges explicitly included in the model	2-4
Table 5.1	TMDL for Chatlin Lake Canal/Bayou du Lac (subsegment 060212).....	5-1
Table 5.2	TMDL for Bayou des Glaises Diversion Channel (subsegment 060207).....	5-1
Table 5.3	Nutrient TMDL for Bayou des Glaises Diversion Channel (subsegment 060207)	5-2
Table 6.1	Summary of results of sensitivity analysis	6-2

1.0 INTRODUCTION

This report presents total maximum daily loads (TMDLs) for dissolved oxygen (DO) and nutrients for subsegments 060212 (Chatlin Lake Canal/Bayou du Lac) and 060207 (Bayou des Glaises Diversion Channel). Both of these subsegments were listed on the February 29, 2000 Modified Court Ordered 303(d) List for Louisiana (EPA 2000a) as not fully supporting the designated use of propagation of fish and wildlife. These subsegments were not included on the 1998 303(d) List (LDEQ 1998), but were later added to the list based on LDEQ assessment data collected during June – December 1998. The suspected sources and suspected causes for impairment in the 303(d) List are included in Table 1.1. Both subsegments were ranked as priority #1 for TMDL development. The TMDLs in this report were developed in accordance with Section 303(d) of the Federal Clean Water Act and EPA's regulations at 40 CFR 130.7. The 303(d) Listings for other pollutants in these subsegments are being addressed by EPA and the Louisiana Department of Environmental Quality (LDEQ) through other documents.

The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant and to establish the load reduction that is necessary to meet the standard in a waterbody. The TMDL is the sum of the wasteload allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The wasteload allocation is the load allocated to point sources of the pollutant of concern, and the LA is the load that is allocated to nonpoint sources (NPS). The MOS is a percentage of the TMDL that accounts for the uncertainty associated with the model assumptions, data inadequacies, and future growth.

Table 1.1. Summary of 303(d) Listing of the 2 subsegments in the study area (EPA 2000a).

Subsegment Number	Waterbody Description	Suspected Sources	Suspected Causes	Priority Ranking (1 = highest)
060207	Bayou des Glaises Diversion Channel/West Atchafalaya Borrow Pit Canal – from Bayou des Glaises to Bayou Courtableau	Municipal point source Non-irrigated crop production	Organic enrichment/ low DO Suspended solids Turbidity Pesticides Nutrients	1
060212	Chatlin Lake Canal and Bayou du Lac – from Alexandria, LA to Bayou des Glaises Diversion Canal (includes 0602 segment of Bayou des Glaises)	Inflow and infiltration Pastureland Urban runoff/Storm sewers Channelization Removal of riparian vegetation Streambank modification/ destabilization	Siltation Oil & Grease Suspended solids Turbidity Pathogen indicators Organic enrichment/ low DO	1

2.0 STUDY AREA DESCRIPTION

2.1 General Information

The subsegments in the study area are part of the Vermilion-Teche basin in southern Louisiana (see map located in Appendix A). Chatlin Lake Canal headwaters are located in Alexandria, LA. Chatlin Lake Canal and Bayou du Lac are part of a complex system of natural streams and man-made canals draining the area between the Red River and Bayou Boeuf. The Bayou des Glaises Diversion Channel prevents most of Bayou des Glaises flow from joining the Red River and diverts it into the West Atchafalaya Basin Protection Levee (WABPL) Borrow Pit Canal. The WABPL Borrow Pit Canal receives drainage from the west Atchafalaya River basin that has been cut off from the Atchafalaya River by the levee. The study area for these TMDLs ends just north of Highway 190, where gated structures allow flow through the levee. Land use data for the study is shown in Table 2.1. Land use in the study area is primarily agricultural.

Table 2.1. Land uses in the study area based on GAP data (USGS 1998).

Land Use Type	% of Total Area	
	060207	060212
Fresh Marsh	0.1	0.1
Saline Marsh	0.0	0.0
Wetland Forest	25.1	16.0
Upland Forest	0.1	0.1
Wetland Scrub/Shrub	1.3	1.7
Upland Scrub/Shrub	0.0	0.0
Agricultural	68.9	76.5
Urban	0.2	1.3
Barren	0.0	0.0
Water	4.3	4.2
TOTAL	100.0%	100.0%

Water in the study area comes primarily from local runoff, and flow is mostly uncontrolled. There is a gated structure at the Bayou des Glaises Diversion Channel to control flow in Bayou des Glaises going to the Red River. Also, as part of a water control plan to restore

low flow to Bayou Teche that was lost when the WABPL was built, water pumped from the Atchafalaya River is released into the WABPL Borrow Pit Canal approximately 2 km north of Highway 190. The timing and rate of this transfer is controlled by the Teche-Vermilion Fresh Water District.

2.2 Water Quality Standards

The numeric water quality standards and designated uses for these subsegments are shown in Table 2.2. The primary numeric standard for the TMDLs presented in this report is the DO standard of 5 mg/L year round.

Table 2.2. Water quality standards and designated uses (LDEQ 2000a).

Subsegment Number	060207	060212
Waterbody Description	Bayou des Glaises Diversion Channel	Chatlin Lake Canal/Bayou du Lac
Designated Uses:	ABC	ABC
Criteria:		
Chloride	100 mg/L	45 mg/L
Sulfate	75 mg/L	35 mg/L
DO	5 mg/L (year round)	5 mg/L (year round)
pH	6.0 – 8.5	6.0 – 8.5
Temperature	32 °C	32 °C
TDS	500 mg/L	100 mg/L

USES: A – primary contact recreation; B – secondary contact recreation; C – propagation of fish and wildlife; D – drinking water supply; E – oyster propagation; F – agriculture; G – outstanding natural resource water; L – limited aquatic life and wildlife use.

2.3 Identification of Sources

2.3.1 Point Sources

Lists of NPDES permits that were identified in or near the subsegments in the study area are included in Appendix B. These permits were identified by searching two sources of information. The primary source was a listing of all the permits in the Vermilion- Teche basin (basin number 06) from the LDEQ static database. The secondary source was a listing of all the permits in the Vermilion-Teche basin from EPA's Permit Compliance System (PCS) on the EPA

website. All of the information concerning permit parameters and design flow in Appendix B was obtained by manually retrieving hard copies of permit files from LDEQ's file room.

Facilities without oxygen demanding parameters in their permit were assumed to exert a negligible oxygen demand in the receiving stream; therefore, these facilities were excluded from any further consideration in these TMDLs. All of the facilities with oxygen demanding parameters in their permit were included in the TMDL calculations. Those with design flows greater than 0.1 MGD were modeled explicitly. The oxygen demanding discharges not explicitly modeled were included in the TMDLs by adding their oxygen demand to the total loading simulated in the model.

The point sources that were explicitly included in the model are listed in Table 2.3. The approximate locations of these dischargers are shown in Appendix A. The permit records, permit applications, and Discharge Monitoring Reports (DMRs) for these facilities were examined and appropriate input information for the calibration and projection modeling runs was derived to the maximum extent possible.

2.3.2 Nonpoint Sources

Several nonpoint sources were cited as suspected sources of impairment in the 303(d) List (Table 1.1). These nonpoint sources include non-irrigated crop production, inflow and infiltration, pastureland, urban runoff, channelization, removal of riparian vegetation, and stream bank modification/destabilization.

2.4 Previous Data and Studies

Listed below are previous water quality data and studies in or near the subsegments in the study area. Locations of the LDEQ ambient monitoring stations are shown in Appendix A.

1. Twice monthly data collected by LDEQ for "Chatlin Lake Canal and Bayou du Lac" (station 672) for mid-June to December 1998. This station is located on Bayou des Glaisses just upstream of the Bayou des Glaisses Diversion Channel.

Table 2.3. Relevant information for discharges explicitly included in the model.

Name	Permit Number	Receiving Stream	Design Flow	Permit Limits	Treatment
Town of Lecompte STP	LA0047031	Rattlesnake Bayou	0.3 MGD	10 mg/L CBOD ₅ , 2 mg/L NH ₃ -N (monthly average) 5 mg/L DO (instantaneous minimum)	
Allen Canning	LA0003344	Choctaw Bayou	0.97 MGD	45 mg/L CBOD ₅ (daily maximum)	Lagoons
Village of Moreauville STP	LA0065064	Bayou des Glaises Diversion Channel	0.155 MGD	20 mg/L CBOD ₅ , 10 mg/L NH ₃ -N (monthly average) 5 mg/L DO (instantaneous minimum)	Activated Sludge
Avoyelles Correctional Facility	LA0083801	Drainage ditch to Bayou Chopique	0.262 MGD	30 mg/L BOD ₅ (daily average)	Oxidation pond and filter
Village of Plaucheville STP	WP3984	Bayou Chopique	0.049 MGD	10 mg/L CBOD ₅ , 2 mg/L NH ₃ -N (daily average) 5 mg/L DO (instantaneous minimum)	Extended aeration
Town of Cottonport STP	LA0040126	Drainage ditch to Bayou Chopique	0.2 MGD	10 mg/L CBOD ₅ , 2 mg/L NH ₃ -N (monthly average) 5 mg/L DO (instantaneous minimum)	Extended aeration

2. Twice monthly data collected by LDEQ for “Bayou des Glaises Diversion Channel” (station 667) for mid-June to December 1998. This station is located on the WABPL Borrow Pit Canal at Hwy 71 bridge.
3. Chatlin Lake Canal and Bayou du Lac TMDL for Fecal Coliform (EPA 2000b).

3.0 CALIBRATION OF WATER QUALITY MODEL

3.1 Model Setup

In order to evaluate the linkage between pollutant sources and water quality, a computer simulation model was used. The model used for these TMDLs was LA-QUAL (version 3.02), which was selected because it includes the relevant physical, chemical, and biological processes and it has been used successfully in the past for other TMDLs in Louisiana. The LA-QUAL model was set up to simulate organic nitrogen, ammonia nitrogen, ultimate carbonaceous biochemical oxygen demand (CBOD_u), and DO. Phosphorus and algae were not simulated because algae do not appear to have significant impacts on DO in these subsegments.

A vector diagram of the model is shown in Appendix C. The vector diagram shows the reach/element design and the location of the modeled inflows and point sources. The model extends from the Highway 3170 bridge on Chatlin Lake Canal near Chambers, LA south to where the WABPL Borrow Pit Canal empties into Darbonne Bay. The main stem of the model includes Chatlin Lake Canal, Bayou du Lac from its confluence with Chatlin Lake Canal to its confluence with Bayou des Glaises, Bayou des Glaises from Bayou du Lac to the Bayou des Glaises Diversion Channel, the Bayou des Glaises Diversion Channel, and the WABPL Borrow Pit Canal from its confluence with the Bayou des Glaises Diversion Channel to Darbonne Bay. Tributaries that are receiving streams for point source dischargers that are explicitly modeled are included in the model as branches. The Bayou Pompey branch includes an unnamed ditch, Rattlesnake Bayou from its confluence with the ditch to its confluence with Bayou Pompey, and Bayou Pompey from its confluence with Rattlesnake Bayou to its confluence with Chatlin Lake Canal. The Bayou du Lac branch includes an unnamed tributary to Choctaw Bayou, Three Prong Lake, and Bayou du Lac from Three Prong Lake to its confluence with Chatlin Lake Canal. The Bayou Chopique branch includes an unnamed tributary to Bayou Chopique and Bayou Chopique from its confluence with the unnamed tributary to its confluence with the WABPL Borrow Pit Canal. Tributaries with drainage areas greater than 10 mi² that were not modeled as branches were included in the model as waste loads. Since neither flow nor water quality data were available for the smaller tributaries, it was not deemed necessary to include them in this model.

3.2 Calibration Period

An intensive field survey was not performed for the study area due to schedule and budget limitations. A synoptic survey of the study area was performed by FTN in September 2000, but only limited data were collected during that survey. Therefore, the model was calibrated to historical conditions when hydrologic and water quality data were available. The only historical period for which water quality data were collected for the subsegments was the June through December 1998 period when LDEQ collected their assessment data. The LDEQ stations for the subsegments in the study area are:

Station 0672 – Chatlin Lake Canal and Bayou du Lac (subsegment 060212)
Station 0667 – Bayou des Glaisses Diversion Channel (subsegment 060207)

The water quality data for this period were retrieved from the LDEQ website. These data are listed in tabular form in Appendix D and the temperature and DO are plotted in Figures D.1 through D.4 (also located in Appendix D). The two conditions that usually characterize critical periods for DO are high temperatures and low flows. High temperatures decrease DO saturation values and increase rates for oxygen demanding processes (BOD decay, nitrification, and sediment oxygen demand). In most systems, low flows cause reaeration rates to be lower. The purpose of selecting a critical period for calibration is so that the model will be calibrated as accurately as possible for making projection simulations for critical conditions.

Based on the data in Appendix D, the calibration period was selected as September 23 to October 14, 1998. This period represented a critical period for DO in both subsegments. The calibration targets (i.e., the concentrations to which the model was calibrated) for each parameter for each LDEQ station was set to the average of the concentrations measured during the calibration period.

3.3 Temperature Correction of Kinetics (Data Type 4)

The temperature correction factors used in the model were consistent with the Louisiana Technical Procedures Manual (the “LTP”; LDEQ 2000b). These correction factors were:

- Correction for BOD decay: 1.047 (value in LTP is same as model default)
- Correction for SOD: 1.065 (value in LTP is same as model default)
- Correction for ammonia N decay: 1.070 (specified in Data Group 4)
- Correction for organic N decay: 1.020 (not specified in LTP; model default used)
- Correction for reaeration: Calculated automatically by the model

3.4 Hydraulics (Data Type 9)

The hydraulics were specified in the input for the LA-QUAL model using the power functions ($\text{width} = a * Q^b + C$ and $\text{depth} = d * Q^e + f$). Low flow conditions were simulated in both the calibration and projection runs. Based on field observations and the low gradient of these streams, it was assumed that changes in the depths and widths of these streams would be negligible between the calibration and projection runs. Therefore, the system was modeled with constant depth and width. This was specified in the model by setting the coefficients and exponents as follows (values for each reach are shown in Appendix E):

- width coefficient (a) = 0.0
- width exponent (b) = 0.0
- width constant (c) = width
- depth coefficient (d) = 0.0
- depth exponent (e) = 0.0
- depth constant (f) = depth

Widths and depths were estimated from cross sections measured during the September 2000 survey and digital ortho quarter quads (aerial photographs).

3.5 Initial Conditions (Data Type 11)

The primary parameter that is specified in the initial conditions for LA-QUAL is the temperature for each reach (because temperature was not being simulated). The temperature was set to the average of the measured values at the LDEQ stations during the calibration period. The input data and sources are shown in Appendix E.

For constituents not being simulated, the initial concentrations were set to zero; otherwise, the model would have assumed a fixed concentration of those constituents and the

model would have included the effects of the unmodeled constituents on the modeled constituents (e.g., the effects of algae on DO).

3.6 Water Quality Kinetics (Data Types 12 and 13)

Kinetic rates used in LA-QUAL include reaeration rates, sediment oxygen demand (SOD), CBOD decay rates, nitrification rates, and mineralization rates (organic nitrogen decay). The values used in the model input are shown in Appendix E.

The SOD rates were developed through iteration in the calibration. The SOD rate for each reach was adjusted so that predicted DO concentrations were similar to the calibration target values. Mineralization rates (organic nitrogen decay) in the model were set to 0.02/day for all reaches. This value was based on information in “Rates, Constants, and Kinetics Formulations in Surface Water Quality Modeling” (EPA 1985). Nitrification rates were set to 0.10/day for all reaches, which is consistent with guidance in the LTP based on stream depth. The combination of these rates is consistent with LDEQ's guidance for uncalibrated modeling of the Mermentau and Vermilion-Teche basins (LDEQ 2000c). The LDEQ guidance specified a default rate of 0.05/day for nitrogenous biochemical oxygen demand (NBOD) decay, which represents the combination of mineralization and nitrification.

One other input value was specified for characterizing the nitrification process. In the program constants section of the model input file (data type 3), the nitrification inhibition option was set to 1 instead of the default of option number 2. With the default option, the nitrification rate drops rapidly when the DO drops below 2 mg/L, which results in an unrealistic build up of ammonia nitrogen at low DO values. Option number 1 provides nitrification inhibition that is similar to what is used in other water quality models such as QUAL2E and WASP (see Figure 3.5 in FTN 2000a).

3.7 Nonpoint Source Loads (Data Type 19)

The nonpoint source loads that are specified in the model can be most easily understood as resuspended load from the bottom sediments and are modeled as SOD, benthic ammonia source rates, CBODu loads, and organic nitrogen loads. The SOD (specified in data type 12), the benthic ammonia source rates (specified in data type 13), and the mass loads of organic nitrogen

and CBODu (specified in data type 19) were all treated as calibration parameters; their values were adjusted until the model output was similar to the calibration target values. The procedure used to calibrate the model is discussed in Section 3.11. The values used as model input are shown in Appendix E.

3.8 Headwater and Tributary Flow Rates (Data Types 20 and 24)

Inflows were initially estimated using field data from the FTN September 2000 synoptic survey. Discharges at the synoptic survey sampling sites were estimated from field measurements of cross section and velocity. These discharges were then converted to areal discharge by dividing by the drainage area of each site. These inflow estimates were checked by comparing the total estimated flow at the Bayou des Glaisses Diversion Channel ($1.39 \text{ m}^3/\text{s}$) to the average of flows reported at the USGS gaging station at that location (station 07383500 Bayou des Glaisses Diversion Channel at Moreauville, LA) during the calibration period ($1.42 \text{ m}^3/\text{s}$). These calculations are included in Appendix E.

3.9 Headwater and Tributary Water Quality (Data Types 21 and 25)

Concentrations of DO, CBODu, organic nitrogen, and ammonia nitrogen were specified in the model for each headwater and tributary inflow. The values used as model input are shown in Appendix E.

The LDEQ monitoring stations are located near the downstream end of each subsegment, but some of the synoptic survey stations were located on headwaters or tributaries. Since the synoptic survey took place during September (the same time of year as the calibration period), it seemed reasonable to use the synoptic survey data for inflow water quality. Averages of the LDEQ water quality data were used for some tributaries close to the monitoring stations.

The LDEQ ambient monitoring data included DO, total organic carbon (TOC), and total Kjeldahl nitrogen (TKN), but not CBOD₅, organic nitrogen, or ammonia nitrogen. Therefore, CBODu was estimated from TOC, and organic nitrogen and ammonia nitrogen were estimated from TKN. Relationships between these parameters were developed using data from the FTN synoptic survey in September 2000 and data from LDEQ's long term BOD analyses during 2000.

The median ratio of TOC to CBOD₅ from the FTN synoptic survey data was 6.0 and the median ratio of CBOD_u to CBOD₅ from the LDEQ long term BOD data was 4.5. Combining these ratios yielded the following relationship that was used to develop model inputs:

$$\text{CBOD}_u = 0.75 * \text{TOC}$$

The median ratio of ammonia nitrogen to TKN from the FTN synoptic survey data was 0.17. This value was similar to the median ratio of ammonia nitrogen to TKN from the LDEQ data. The organic nitrogen was then determined as TKN minus ammonia nitrogen. This yielded the following relationships that were used to develop model inputs:

$$\text{Ammonia nitrogen} = 0.17 * \text{TKN}$$

$$\text{Organic nitrogen} = 0.83 * \text{TKN}$$

3.10 Point Source Inputs (Data Types 24 and 25)

Flows and water quality concentrations for the modeled point sources were based on averages of the values on their discharge monitoring reports (DMRs) for September and October 1998. The CBOD_u values used for model input were obtained by multiplying the BOD₅ values from the DMRs by an assumed CBOD_u:BOD₅ ratio of 2.3 (which is consistent with the LTP). Water quality parameters not included on the DMR were set based on permit limits and the LTP guidelines or water quality of the receiving stream. The values used as model input are shown in Appendix E.

3.11 Calibration Methodology

The model was calibrated by adjusting 4 input parameters: organic nitrogen loads, benthic ammonia source rates, CBOD mass loads, and SOD. First, the organic nitrogen loads were adjusted until the predicted organic nitrogen concentrations were similar to the observed concentrations. Organic nitrogen was calibrated first because none of the other state variables (DO, CBOD, ammonia nitrogen) will affect the organic nitrogen concentrations. Next, the benthic ammonia source rates were adjusted until the predicted ammonia nitrogen concentrations were similar to the observed concentrations. Then the CBOD loads were adjusted until the

predicted CBOD concentrations were similar to the observed concentrations. Finally, SOD was adjusted until the predicted DO concentrations were similar to the observed concentrations.

3.12 Model Results for Calibration

Plots of predicted and observed water quality for the calibration are presented in Appendix F and a printout of the LA-QUAL output file is included as Appendix G. The calibration was considered to be acceptable based on the amount of data that were available.

4.0 WATER QUALITY MODEL PROJECTION

EPA's regulations at 40 CFR 130.7 require the determination of TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. Therefore, the calibrated model was used to project water quality for critical conditions. The identification of critical conditions and the model input data used for critical conditions is discussed below.

4.1 Identification of Critical Conditions

Section 303(d) of the Federal Clean Water Act and EPA's regulations at 40 CFR 130.7 both require the consideration of seasonal variation of conditions affecting the constituent of concern and the inclusion of a margin of safety (MOS) in the development of a TMDL. For the TMDLs in this report, analyses of LDEQ long-term ambient data were used to determine critical seasonal conditions. A combination of implicit and explicit margins of safety was used in developing the projection model.

Critical conditions for DO have been determined for the Mermentau basin in previous TMDL studies. The analyses concluded that the critical conditions for stream DO concentrations occur during periods with negligible nonpoint runoff, low stream flow, and high stream temperature.

When the rainfall runoff (and nonpoint loading) and stream flow are high, turbulence is higher due to the higher flow and the stream temperature is lowered by the cooler precipitation and runoff. In addition, runoff coefficients are higher in cooler weather due to reduced evaporation and evapotranspiration, so that the high flow periods of the year tend to be the cooler periods. DO saturation values are, of course, much higher when water temperatures are cooler, but BOD decay rates are much lower. For these reasons, periods of high loading are periods of higher reaeration and DO but not necessarily periods of high BOD decay.

LDEQ interprets this phenomenon in its TMDL modeling by assuming that the annual nonpoint loading, rather than loading for any particular day, is responsible for the accumulated benthic blanket of the stream, which is, in turn, expressed as SOD and/or resuspended BOD in

the model. This accumulated loading has its greatest impact on the stream during periods of higher temperature and lower flow.

According to the LTP, critical summer conditions in DO TMDL projection modeling are simulated by using the annual 7Q10 flow or 0.1 cfs, whichever is higher, for all headwaters, and 90th percentile temperature for the summer season. Model loading is from point sources, perennial tributaries, SOD, and resuspension of sediments. Again, model loading is from point sources, perennial tributaries, SOD, and resuspension of sediments. In addition, all point sources are assumed to be discharging at design capacity.

In reality, the highest temperatures occur in July-August, the lowest stream flows occur in October-November, and the maximum point source discharge occurs following a significant rainfall, i.e., high-flow conditions. The combination of these conditions plus the impact of other conservative assumptions regarding rates and loadings yield an implicit MOS that is not quantified. Over and above this implicit MOS, an explicit MOS of 20% for point sources and 10% for nonpoint sources was incorporated into the TMDLs in this report to account for future growth and model uncertainty.

4.2 Temperature Inputs

The LTP (LDEQ 2000b) specified that the critical temperature should be determined by calculating the 90th percentile seasonal temperature for the waterbody being modeled. Because the LDEQ stations in the study area have only 6 months of temperature data, LDEQ data from a nearby subsegment were used for this analysis. The average of June through December 1998 water temperatures at LDEQ station 672 (Chatlin Lake Canal) was 25.1°C. The average of June through December 1998 temperatures at Bayou Boeuf north of Washington (LDEQ station 0668) was 25.0°C. Therefore, long-term temperature data for Bayou Boeuf was used to estimate the 90th percentile temperature for the study area. In the Bayou Boeuf TMDL (LDEQ 1999), long term temperature data from the Bayou Boeuf near Milburn (LDEQ station 0104) were used to calculate a 90th percentile summer temperature of 28.2°C. These values were specified in data type 11 in the model input and are shown in Appendix H.

Because the subsegments have a year round standard for DO, a winter projection simulation was not performed. As discussed above, the most critical time of year for meeting a constant DO standard is the period of high temperatures and low flows (i.e., summer).

4.3 Headwater and Tributary Inputs

The inputs for the headwaters and tributaries for the projection simulation were based on guidance in the LTP. According to the LTP, the critical flow rates for summer should be set to either the 7Q10 flow or 0.1 cfs, whichever is higher. Also, the LTP specifies that the DO concentration for headwater and tributary inflows should be set to 90% saturation at the critical temperature. The values used as model input in the projection simulation are shown in Appendix H.

7Q10 flows for the headwaters and tributaries were estimated from reported 7Q10 flows for the two USGS stations in the study area (073830 – Chatlin Lake Canal near Lecompte, LA and 073835 – Bayou des Glaisses Diversion Channel at Moreauville, LA). The reported 7Q10 flows were divided by the drainage areas for the stations to calculate areal 7Q10 flows. The areal 7Q10 flows for the Bayou des Glaisses Diversion Channel station was about 3 times greater than the areal 7Q10 flow for the Chatlin Lake Canal station. Since the Bayou des Glaisses Diversion Channel 7Q10 flow was based on 32 years of data, compared to 11 years of data at the Chatlin Lake Canal station, the Bayou des Glaisses Diversion Channel area 7Q10 flow was used to estimate inflows for the projection model. This areal 7Q10 flow was multiplied by the headwater or tributary drainage area to estimate the flow. All of the estimated 7Q10 flows were greater than 0.1 cfs. These calculations are included in Appendix H.

Headwater and tributary DO concentrations were set to 90% of the saturated DO concentration at the projection water temperature. The other water quality concentrations used for these inflows in the calibration were assumed to be representative of critical conditions and were used in the projection also.

4.4 Point Source Inputs

The point source flows were set to 125% of the design flow in order to incorporate an explicit 20% margin of safety. Concentrations of permitted parameters were set to the permit limits. All other water quality concentrations were the same as for the calibration. Point source inputs for the projection simulation are shown in Appendix H.

Initial projection simulations showed DO concentrations less than 5 mg/L in the Bayou des Glaisses Diversion Channel even with over 50% reduction of nonpoint source oxygen demand load. The Village of Moreauville discharge was contributing to the low DO concentrations. Since the Village of Moreauville permit limits were greater than any of the other STPs discharging in the subsegment, we assumed that treatment at the Village of Moreauville would be upgraded so that the permit limits would be half of the current permit limits. Therefore, the Village of Moreauville was modeled with CBOD₅ of 10 mg/L and ammonia nitrogen of 5 mg/L in the projection.

Initial projection simulations also showed DO concentrations less than 5 mg/L in Bayou Pompeny, Bayou du Lac upstream of the confluence with Chatlin Lake Canal, and Bayou Chopique, even when nonpoint sources of oxygen demand were reduced 50%. Therefore, we assumed that some of the point source dischargers would upgrade treatment in the projection. The Town of Lecompte and the Town of Cottonport STPs were upgraded to a CBOD₅ limit of 5 mg/L. Allen Canning was upgraded to a CBOD₅ limit of 10 mg/L. No changes in permit limits were assumed for the other point source discharges in the study area. Because of their small discharge flows, these dischargers did not have as great an effect on the stream DO concentrations.

4.5 Nonpoint Source Loads

Because the initial projection simulation was showing low DO values in all of the reaches, the nonpoint source loadings were reduced until all of the predicted DO values were equal to or greater than the water quality standard of 5.0 mg/L. Within each reach, the same percent reduction was applied to all components of the nonpoint source loads (SOD and mass

loads of CBODu and organic nitrogen). The values used as model input in the projection simulation are shown in Appendix H.

4.6 Other Inputs

The only model inputs that were changed from the calibration to the projection simulation were the inputs discussed above in Sections 4.2 through 4.5. All of the other model inputs (e.g., hydraulic and dispersion coefficients, decay rates, reaeration rates, etc.) were unchanged from the calibration simulation.

4.7 Model Results for Projection

Plots of predicted water quality for the projection are presented in Appendix I and a printout of the LA-QUAL output file is included as Appendix J.

For all reaches except Reach 1, nonpoint source load reductions of 38% to 67% were required to bring predicted DO concentrations to at least 5.0 mg/L in all of the branches of the model. In Reach 1, a 2% reduction of nonpoint source loads was required for predicted DO concentrations to meet the 5.0 mg/L standard. In the main branch of the model nonpoint source load reductions varied from 2% to 67%. Nonpoint source load reductions for Bayou Pompey branch were 53%. In the branch modeling Bayou du Lac upstream of the confluence with Chatlin Lake Canal, nonpoint source reductions varied from 38% to 61%. Nonpoint source load reductions for the Bayou Chopique branch of the model were 53% and 57%.

The percentage reductions for nonpoint source loads mentioned above represent percentages of the entire nonpoint source loading, not the manmade nonpoint source loading.

It is possible that for most of the reaches predicted DO concentrations could have met the DO standard by projecting reductions just in the nonpoint source oxygen demand. However, it is difficult to achieve reductions over 50% in nonpoint source oxygen demand and it seemed reasonable to expect similar reductions in point source oxygen demand also. Therefore, the projection assumes reductions in both point and nonpoint sources of oxygen demand.

5.0 WATER QUALITY MODEL PROJECTION

5.1 Calculated DO TMDL, WLAs and LAs

TMDLs for the oxygen demanding constituents (CBOD_u, ammonia nitrogen, organic nitrogen, and SOD), have been calculated for the projection run. A summary of the loads is presented in Tables 5.1 and 5.2. The loads presented in these tables represent the sum of the loads from all portions of the systems that were modeled. The MOS for point sources was set to 20% of the load. The MOS for nonpoint sources was set to 10% of the load. The TMDL calculations are shown in Appendix K.

Table 5.1. TMDL for Chatlin Lake Canal/Bayou du Lac (subsegment 060212).

Source of Oxygen Demand	Oxygen Demand from				Total Oxygen Demand (kg/d)
	CBOD _u	Organic N	Ammonia N	SOD	
WLA for Point Sources	48	8	11	n.a.	67
WLA for Minor Point Sources	33	n.a.	25	n.a.	58
MOS for Point Sources	20	2	9	n.a.	31
LA for Nonpoint Sources	107	250	13	2853	3222
MOS for Nonpoint Sources	12	28	1	317	358
Total Maximum Daily Load	220	289	59	3169	3736

Table 5.2. TMDL for Bayou des Glaisses Diversion Channel (subsegment 060207).

Source of Oxygen Demand	Oxygen Demand from				Total Oxygen Demand (kg/d)
	CBOD _u	Organic N	Ammonia N	SOD	
WLA for Point Sources	29	4	11	n.a.	43
WLA for Minor Point Sources	282	n.a.	217	n.a.	499
MOS for Point Sources	78	1	57	n.a.	136
LA for Nonpoint Sources	2183	52	9	1562	3805
MOS for Nonpoint Sources	243	6	1	174	423
Total Maximum Daily Load	2813	62	295	1736	4906

5.2 Calculated Nutrient TMDL, WLAs and LAs

Nutrient TMDLs were also calculated for the Bayou des Glaisses Diversion Channel (subsegment 060207). Louisiana has no quantitative nutrient standards, instead the regulation states that “the naturally occurring range of nitrogen-phosphorus ratios shall be maintained.” (LDEQ 2000). For this TMDL nutrients were defined as inorganic nitrogen (e.g., $\text{NH}_3\text{-N}$ and $\text{NO}_3\text{+NO}_2\text{-N}$), and total phosphorus. The naturally occurring ratio used was 1.96, which is the median inorganic nitrogen to total phosphorus ratio from the US EPA’s 1974 National Eutrophication Survey. This data was previously used in the Lake Fausse Pointe TMDL (FTN 2000), and was provided by LDEQ.

Ammonia and Nitrate-Nitrite are simulated in the model. Total phosphorus was not simulated in the model. Instead it was back-calculated from the inorganic nitrogen load and the inorganic nitrogen to total phosphorus ratio. Table 5.3 presents the nutrient TMDL for subsegment 060207.

Table 5.3. Nutrient TMDL for Bayou des Glaisses Diversion Channel (subsegment 060207).

Source of Nutrients	Ammonia-N (kg/d)	Nitrate-Nitrite-N (kg/d)	Total P (kg/d)
WLA for Point Sources	2.6	0.0	1.3
WLA for Minor Point Sources	62.7	n.a.	32.1
MOS for Point Sources	16.3	0.0	8.3
LA for Nonpoint Sources	2.0	0.18	1.1
MOS for Nonpoint Sources	0.2	0.02	0.1
Total Maximum Daily Load	83.8	0.2	42.9

5.3 Summary of NPS Reductions and Point Source Upgrades

In summary, the projection modeling used to develop the TMDLs above showed that NPS loads need to be reduced an average of 47% in subsegment 060212 and an average of 58% in subsegment 060207 to maintain the DO standard during the critical period. Reductions of point source oxygen demand were also required. In subsegment 060212, CBOD₅ permit limits for the Town of Lecompte STP and Allen Canning were reduced. In subsegment 060207, CBOD₅ and

ammonia nitrogen limits for the Village of Moreauville STP and CBOD₅ limit for the Town of Cottonport were reduced.

5.4 Seasonal Variation

As discussed in Section 4.1, critical conditions for DO in Louisiana waterbodies have been determined to be when there is negligible nonpoint runoff and low stream flow combined with high water temperatures. In addition, the models account for loadings that occur at higher flows by modeling SOD, resuspended CBOD, and organic nitrogen. Oxygen demanding pollutants that enter the waterbodies during higher flows settle to the bottom and then exert the greatest oxygen demand during the high temperature seasons.

5.5 Margin of Safety

The MOS accounts for any lack of knowledge or uncertainty concerning the relationship between load allocations and water quality. As discussed in Section 4.1, the highest temperatures occur from July through August, the lowest stream flows occur in October and November, and the maximum point source discharge occurs following a significant rainfall, i.e., high-flow conditions. The combination of these conditions, in addition to other conservative assumptions regarding rates and loadings, yields an implicit MOS that is not quantified. In addition to the implicit MOS, the TMDLs in this report included explicit margins of safety of 20% for point source loads and 10% for nonpoint source loads.

6.0 SENSITIVITY ANALYSES

All modeling studies necessarily involve uncertainty and some degree of approximation. It is therefore of value to consider the sensitivity of the model output to changes in model coefficients, and in the hypothesized relationships among the parameters of the model. The LA-QUAL model allows multiple parameters to be varied with a single run. The model adjusts each parameter up or down by the percentage given in the input set. The rest of the parameters listed in the sensitivity section are held at their original projection value. Thus the sensitivity of each parameter is reviewed separately. A sensitivity analysis was performed on the summer projection. The percent change of the model's minimum DO projections to these parameters is presented in Table 5.1. Each parameter was varied by $\pm 30\%$, except for temperature, which was varied $\pm 2^\circ\text{C}$.

Values reported in Table 6.1 are sorted by percentage variation of minimum DO from smallest percentage variation to largest. Reaeration is the parameter to which DO is most sensitive (12% to 24%). The other parameters creating major variations in the minimum DO values are SOD (4% to 16%), velocity (2% to 12%), and temperature (6% to 10%). The model results were slightly sensitive to headwater flow, wasteload flow, and increases in wasteload concentrations of BOD and DO with variations in predicted DO ranging from $<1\%$ to 2%. The model was not sensitive to decay rates, wasteload organic nitrogen nor wasteload ammonia nitrogen.

Table 6.1. Summary of results of sensitivity analysis.

Input Parameter	Parameter Change	Predicted minimum DO (mg/L)	Percent Change in Predicted DO (%)
Baseline	-	5.00	N/A
Headwater flow	+30%	5.00	<1
Organic N Decay Rate	-30%	5.00	<1
Wasteload Organic N	-30%	5.00	<1
Organic N Decay Rate	+30%	5.00	<1
Wasteload Organic N	+30%	5.00	<1
NH3 Decay Rate	+30%	5.00	<1
Wasteload Flow	+30%	5.00	<1
Wasteload NH3	+30%	5.00	<1
NH3 Decay Rate	-30%	5.00	<1
Wasteload NH3	-30%	5.00	<1
BOD Decay Rate	-30%	5.00	<1
Wasteload BOD	-30%	5.00	<1
Depth	-30%	5.00	<1
Wasteload DO	+30%	5.00	<1
Headwater Flow	-30%	4.90	2
Wasteload Flow	-30%	4.90	2
Velocity	-30%	4.90	2
BOD Decay Rate	+30%	4.90	2
Depth	+30%	4.90	2
Wasteload BOD	+30%	4.90	2
Wasteload DO	-30%	4.90	2
SOD	-30%	5.20	4
Initial Temperature	-2 °C	5.30	6
Initial Temperature	+2 °C	4.50	10
Velocity	+30%	4.40	12
Reaeration	+30%	5.60	12
SOD	+30%	4.20	16
Reaeration	-30%	3.80	24

7.0 CONCLUSIONS

This TMDL has been developed to be consistent with the antidegradation policy in the LDEQ water quality standards (LAC 33:IX.1109.A).

Based on this modeling, maintaining the summer water quality standard for both subsegments (060212 and 060207) would require significant reductions of oxygen demanding loads. These reductions include four of the point source dischargers as well as reductions of nonpoint source loads for all subsegments. These reductions are summarized below in Table 6.1.

Table 7.1. Treatment Plant Upgrades and NPS Load Reductions Required to Meet DO Standards in Summer and Winter.

Avoyelles Correctional Facility	Village of Plaucheville STP	Village of Moreauville STP	Town of Lecompte STP	Town of Cottonport STP	Allen Canning	Average Nonpoint Source Load Reduction	
						Chatlin Lake Canal/ Bayou du Lac (060212)	Bayou des Glaises Diversion Channel (060207)
No Change	No Change	Upgrade ¹	Upgrade ²	Upgrade ²	Upgrade ³	47%	58%

¹Upgrade to discharge concentrations of 10 mg/L CBOD₅, 2 mg/L ammonia nitrogen

²Upgrade to discharge concentrations of 5 mg/L CBOD₅

³Upgrade to discharge concentrations of 10 mg/L CBOD₅

LDEQ will work with other agencies such as local Soil Conservation Districts to implement agricultural best management practices in the watershed through the 319 programs. LDEQ will also continue to monitor the waters to determine whether standards are being attained.

In accordance with Section 106 of the federal Clean Water Act and under the authority of the Louisiana Environmental Quality Act, the LDEQ has established a comprehensive program for monitoring the quality of the state's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-

term data base for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the state's biennial 305(b) report (Water Quality Inventory) and the 303(d) List of impaired waters. This information is also utilized in establishing priorities for the LDEQ nonpoint source program.

The LDEQ has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled over a five-year cycle with two targeted basins sampled each year. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the five-year cycle. Sampling is conducted on a monthly basis or more frequently if necessary to yield at least 12 samples per site each year. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, targeted basins follow the TMDL priorities. In this manner, the first TMDLs will have been implemented by the time the first priority basins will be monitored again in the second five-year cycle. This will allow the LDEQ to determine whether there has been any improvement in water quality following implementation of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d)list. The sampling schedule for the first five-year cycle is shown below.

1998 – Mermentau and Vermilion-Teche Basins
 1999 – Calcasieu and Ouachita River Basins
 2000 – Barataria and Terrebonne Basins
 2001 – Lake Pontchartrain Basin and Pearl River Basin
 2002 – Red and Sabine River Basins

(Atchafalaya and Mississippi Rivers will be sampled continuously.)

Mermentau and Vermilion-Teche Basins will be sampled again in 2003.

8.0 REFERENCES

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**APPENDICES A THROUGH K ARE
AVAILABLE FROM EPA UPON REQUEST**

APPENDIX L

Responses to Comments

COMMENTS AND RESPONSES
CHATLIN LAKE CANAL/BAYOU DU LAC AND BAYOU DES GLAISES
DIVERSION CANAL TMDLs FOR DO AND NUTRIENTS
April 19, 2002

EPA appreciates all comments concerning these TMDLs. Comments that were received are shown below with EPA responses inserted in a different font.

GENERAL COMMENTS FROM LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY (LDEQ) (some of these comments may not apply to this report):

In view of LDEQ's TMDL development schedule and the rapidly approaching deadline, LDEQ has made a limited review of the TMDLs published by EPA on October 15, 2001. LDEQ expects to make a more detailed review on at least some of these TMDLs after the first of the year. In the future, LDEQ requests that EPA provide hard copies of the TMDLs and Appendices for LDEQ review. Several electronic files required software which is not used by LDEQ thus making it impossible to review some portions of several TMDLs. Hard copies will insure that the complete official document is being reviewed and will eliminate the time required for LDEQ to try to put together the document from electronic files. In general, LDEQ found these TMDLs to be unacceptable, based on inadequate data and not implementable.

Federal Register Notice: Volume 66, Number 199, pages 52403 - 52404 (10/15/2001)

- A. Vermilion River Cutoff DO and Nutrients .pdf
- B. Bayou Chene DO .pdf
- C. Bayou du Portage DO .pdf
- D. Bayou Mallet DO, Nutrients and Ammonia .pdf
- E. Bayou Petite Anse DO and Nutrients .pdf
- F. Bayou Tigre DO and Nutrients .pdf
- G. Big Constance Lake and Mermentau Coastal Bays and Gulf Water TMDLs for DO and Nutrients .pdf
- H. Charenton Drainage and Navigation Canal and West Cote Blanche Bay TMDLs for DO and Nutrients.pdf
- I. Chatlin Lake Canal/Bayou Du Lac and Bayou Des Glaises Diversion Channel TMDLs for DO and Nutrients.pdf
- J. Dugas Canal DO and Nutrients .pdf
- K. Franklin Canal DO and Nutrients .pdf
- L. Freshwater Bayou Canal DO and Nutrients .pdf
- M. Irish Ditch/Big Bayou DO .pdf

- N. Lake Arthur, Grand Lake, and Gulf Intracoastal Waterway TMDLs for DO, Nutrients, and Ammonia .pdf
- O. Lake Peigneur DO and Nutrients .pdf
- P. New Iberia Southern Drainage Canal DO and Nutrients .pdf
- Q. Spanish Lake DO .pdf
- R. Tete Bayou DO and Nutrients .pdf
- S. Bayou Carron DO and Nutrients .pdf
- T. West Atchafalaya Basin Protection Levee Borrow Pit Canal DO.pdf

1. Many of these TMDLs are based on models using historical water quality data gathered at a single location rather than survey data gathered at several sites spaced throughout the waterbody. Hydraulic information used was generally not taken at the same time as the water quality data used. The availability of only one water quality data site is not sufficient justification to simulate the subsegment using a one reach, one element model. Additional reaches and elements must be used to represent the subsegment and additional data must be obtained in order for these TMDLs to be valid. The recommended maximum limits cited in the LAQUAL User's Manual for element width and length have been grossly exceeded in many of the models. The spreadsheet calibration and projection graphs that were provided do not match the plots produced by the LA-QUAL model. Please explain why they do not match. The LAQUAL graphics for a few elements produces a graph that does not represent the model output. It's an anomaly of the graphics routine. The calibrations are inadequate due to the lack of a hydrologic calibration and the paucity of water quality data. The resulting TMDLs are invalid. LDEQ does not accept these TMDLs.

Response: The TMDLs were based on existing data plus information that could be obtained with available resources. Each model was developed using the most appropriate hydraulic information and water quality data that were available. The level of detail at which each subsegment was modeled was consistent with the amount of available data. Although having only one element in a model causes inaccuracies in the LAQUAL graphics, having only one element in a model does NOT cause errors in the tabular output (which is what the graphs in the reports are based on). Although LDEQ typically collects more data for model calibration than what was available for calibration of these models, EPA considers these model calibrations and the resulting TMDLs to be valid.

2. LDEQ does not consider any of these waters to be impaired due to nutrients or ammonia. LDEQ does not consider Vermilion River Cutoff (060803), Mermentau Coastal Bays and Gulf Water (050901), Charenton Drainage and Navigation Canal (060601), West Cote Blanche Bay (061001), Bayou Des Glaisses Diversion channel (060207), Grand Lake (070701), Gulf Intracoastal Waterway (050702), Lake Peigneur (060909), New Iberia Southern Drainage Canal (060904) and West Atchafalaya Basin Protection Levee Borrow Pit Canal to be impaired by biochemical oxygen-demanding substances. Many of these waters simply have inappropriate

standards and criteria. The resources spent on developing these TMDLs could have been far more effectively and wisely spent on reviewing, approving, and assisting in the development of appropriate standards and criteria for these waters through the UAA process.

Response: TMDLs were developed for these subsegments based on the requirements of Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7 and the suspected causes of impairment (organic enrichment/low DO, nutrients, or ammonia) for each subsegment in the EPA Modified Court Ordered 303(d) List.

3. Remove the reference and all references to the unpublished LDEQ document, "Defaults for Uncalibrated Modeling". This is not an acceptable reference and any defaults selected on this basis must be reevaluated and based on acceptable references. Some of the models must be redone because of inappropriately selected defaults. At this time, LDEQ has no plans to revise, complete or publish this document.

Response: The unpublished LDEQ document that is mentioned here was provided to EPA's contractor without any instructions not to use it. The model coefficients listed in that document appear to be reasonable and consistent with values used in other modeling studies in southern Louisiana.

4. The percent reduction of the nonpoint source load must not be reported as an overall average of the individual percent reduction applied to each reach. This approach does not insure that standards will be met in all reaches and will be difficult to implement. In consideration of future implementation plans, LDEQ does not vary the percent reduction required from reach to reach. LDEQ uses a uniform percent reduction within a watershed unless there are unique conditions, such as a general change in landuse, that dictate a further breakdown. These unique conditions must be adequately documented in the report in order to facilitate future implementation plans. Specifying type of land use is helpful in defining nonpoint loading. LDEQ requests a calculation sheet of the NPS reduction percentages and asks that language be added to the report describing the calculation process.

Response: EPA appreciates this comment but believes that an average percent reduction is acceptable. EPA will consider this in future development of TMDLs in Louisiana.

In the lower Mermentau and Vermilion River Basins, much of the nonpoint loading affecting some of these subsegments and adding to their benthic blanket is coming from the tributaries feeding them. Many of the headwater tributaries have recent TMDL's that require dramatic percentage reductions to the nonpoint contributions. By implementing the reductions to nonpoint loads upstream, the current problems in these lower subsegments will be reduced.

Response: EPA recognizes that TMDLs have been developed upstream of several of these subsegments. Implementing upstream reductions in nonpoint loads should require much less reduction of loadings from within these subsegments. The required percent reductions for these subsegments were not intended to be in addition to upstream reductions.

5. The percentage reductions listed were not calculated based on the written procedure described in several TMDLs. These values did not take the MOS into consideration. It is also LDEQ's policy to make a no-man-made load projection run which will estimate the natural background loads. The contractor should include a no-man-made load projection run in each TMDL report.

Response: The percent reductions were calculated by subtracting the projection input value from the calibration input value and then dividing by the calibration input value. This procedure is slightly different than what LDEQ uses but still provides percent reductions that are useful.

6. CBODu and NH3-N were estimated from surrogate parameters rather than actual measured data for most of the TMDLs. Based on the measured data from the last two years of LDEQ water quality surveys, LDEQ objects to the correlation of TOC to CBOD and NH3-N to TKN, unless these correlations are taken from water quality data on the modeled waterbody. Our studies have shown only a moderate correlation between these two parameters within the same waterbody, however when this correlation was attempted across waterbodies extreme variability was seen and the correlation was not judged valid. It is possible that a combination of surrogates will obtain a better correlation, such as TOC along with color, turbidity, pH, etc. LDEQ is currently researching these options.

Response: EPA agrees that it would be ideal to have data collected from the modeled waterbody for relating TOC to CBOD and NH3-N to TKN. However, for these subsegments, there was insufficient data from which these relationships could be developed.

7. LDEQ takes exception to the equating of COD to CBODu in some of the TMDLs. There is no data to support this assumption. No direct correlation has been drawn between these two parameters. The only correlations that have been found are variable and dependant on the type of discharge. LDEQ requests that facilities with only COD limits be removed from the WLA load calculations.

Response: EPA agrees that COD is not an ideal indicator of CBODu. However, EPA believes that most effluents that exert significant COD are likely to exert some oxygen demand in natural waterbodies and therefore the discharges with COD limits should be included in the TMDLs.

8. CBODU and Org-N settling rates were not used. This is not justifiable in areas dominated by agricultural activities and is poor practice for TMDLs on Louisiana waters. The models must be revised to include settling rates.

Response: Without the use of settling rates, all of the pollutant loading remains in the water column where it can consume oxygen. Depending on the model settings for conversion of settled pollutant loading to SOD, the model can be more conservative without settling rates. Other applications of water quality models for TMDLs on southern Louisiana waterbodies have not used settling rates and have been approved by LDEQ.

9. The TMDLs should be for biochemical oxygen-demanding substances instead of DO. DO is an indicator of the impact of biochemical oxygen demanding load, hydrologic modifications, excessive algae blooms, etc.

Response: The TMDLs in Section 5 of each report are already expressed in terms of oxygen demand.

10. Nitrification inhibition option number 2 is valid for Louisiana's waterbodies. Various studies have shown that Louisiana does not have a buildup of NH₃-N in its waterbodies. If option 1 was needed for a proper calibration then that should be stated as such.

Response: The nitrification inhibition option was set based on algorithms in other widely used water quality models. Option 1 has been used in other water quality modeling applications for TMDLs on southern Louisiana waterbodies that have been approved by LDEQ.

11. A winter projection model was not developed for most of the TMDLs. Winter projection models must be developed to address seasonality requirements of the Clean Water Act. Where point sources have seasonally variable effluent limitations or such seasonal variations are proposed, a winter projection model is required to show that standards are met year-round.

Response: As discussed in Section 4.2 of each report, summer is the most critical season for meeting the year round standard for DO for this subsegment. Therefore, the summer simulation satisfies the seasonality requirements of the Clean Water Act. Performing additional simulations to evaluate permit limits that are seasonal or hydrograph controlled releases was not required for developing these TMDLs and can be done by LDEQ or by permittees.

12. There was no documentation (LA-QUAL plots) to indicate that the model was calibrated to all hydrologic parameters (i.e. flow, width, depth, time of travel, velocity, chloride balance, etc.). Apparently flow balances were performed, however a flow balance is not a hydrologic calibration. Most of the models must be recalibrated with adequate hydrologic data. Calibration plots for all of the hydrologic parameters must be provided in the appendices.

Response: The values of depth, width, and flow in each model were estimated based upon the most appropriate available information. Hydraulic calibration of each model was not possible due to a lack of data.

13. The calibration and projection plots for dissolved oxygen must be provided in the body of the reports. Additional projection plots for CBODU, NH₃-N, and Org-N must be provided in the appendices.

Response: The placement and number of plots in the draft reports are acceptable.

14. The calibration simulation must be used as the baseline for the sensitivity analysis, not the projection simulation. LDEQ requests that all TMDLs be revised in this regard.

Response: The sensitivity analysis can be developed using either the calibration or the projection as a baseline. EPA will consider this in future development of TMDLs in Louisiana.

15. A list of all point source dischargers must be provided in the body of the reports. Only dischargers with flows that reach the named waterbody should be included in the TMDLs.

In several TMDLs, a default 0.001 MGD flow rate was assigned to dischargers where a flow rate was not available. This practice is unacceptable to LDEQ. This default flow rate is extremely low (LDEQ would typically use 0.005 MGD as a minimum) and could strictly limit these dischargers' allowable permit loads when their permits are renewed. Additional research should be done to determine the facility type and anticipated flow rates of these facilities.

Response: The placement of the list of point source dischargers in the draft reports is acceptable. The dischargers with no flow rate information are believed to have very small flow rates representing a very small portion of the total TMDLs. The actual flow rate for each facility can be determined by LDEQ when the facility's permit is being renewed.

16. LDEQ does not agree with the minor point sources loads being subtracted from the NPS load as was done in several of the TMDLs. The pollutant loads being addressed are non-conservative loads. Many of these dischargers are located on small tributaries to the 303(d) waterbody which have recovered prior to entering into that system. Thus they are not contributing to the pollutant loads in the impaired waterbody. LDEQ's current procedure is to add these loads to the WLA portion of the TMDL.

Response: In the reports for which this comment is applicable, the TMDL calculations have been revised so that these loads are added to the WLA portion of the TMDL (same as LDEQ's procedure). For most of the draft reports, the TMDL calculations already used LDEQ's procedure of adding the minor point sources to the modeled loads.

17. Proper justification must be provided when using a nonpoint source margin of safety value other than the typical LDEQ value of 20%.

Response: The nonpoint margin of safety (MOS) was set to 10% based on other TMDLS on southern Louisiana waterbodies that have either been developed by LDEQ or approved by LDEQ. Eleven TMDL reports from LDEQ's website were reviewed to examine the explicit MOS for nonpoint sources. All 11 of these TMDLS were for oxygen demanding substances in the Mermentau or Vermilion-Teche basins. The explicit MOS for nonpoint sources was set to 20% for 2 reports, 10% for 3 reports, and 0% for 6 reports. Therefore, the value of 10% was considered to be a typical value that did not need special justification.

18. LDEQ has major concerns relating to the use of a one dimensional steady state model in coastal bays, lakes and estuaries. These systems are typically dominated by tides and winds and do not behave like riverine systems. LAQUAL can be used to simulate estuarine systems with riverine characteristics and some tidal influences; however to use it in these applications exceeds the model's recommended input limitations and appears to produce a meaningless output. Also the systems' unique hydrological characteristics do not adapt well to LAQUAL's one-dimensional capabilities. A multi-dimensional model such as WASP should be used for these waters. While a dynamic model would be preferred, a steady-state multi-dimensional model would be acceptable if it adequately addresses tidal influences. LDEQ objects to the use of LAQUAL in determining TMDLS for coastal bays, lakes and estuaries.

Response: A one dimensional steady state model such as LAQUAL was considered to be appropriate for all of these subsegments based on the amount of data that were available. Proper application of a multi-dimensional model or a dynamic model would require much more data and is simply not necessary for these waterbodies. For large, wide waterbodies, WASP will yield the same results as LAQUAL if the configuration of elements and model coefficients are the same between the two models.

19. The report uses the term synoptic survey multiple times. Please describe in detail what area this survey encompassed as well as site locations and what parameters were tested. Also, the raw data from this survey must be included in the appendices as support for the model inputs and calculations.

Response: A description of the synoptic survey and a summary of the data have been added to the appendices for each report in which those data are used.

20. In many of the calibration models the average water quality data from several LDEQ stations were used. It has been LDEQ's experience that a better calibration can be accomplished by using a single day's water quality and flow data. The additional daily values could then be used to perform multiple verifications of the model parameters before proceeding to the projection

stage. The flow data should be collected at the same time as the water quality data in order for the model to be valid.

Response: The models were calibrated to averages over multiple sampling events to minimize the effects of any single field measurement that might be of questionable quality or indicative of conditions that may have lasted only a very short time. For large systems with long residence times, using only a single snapshot of water quality data is often not representative of steady state conditions for that system.

21. Grammatical errors and misspelled words were found in these reports.

Response: The reports have been reviewed for grammar and spelling.

22. There does not appear to be any significant anthropogenic source of nutrients from agriculture, silviculture, aquaculture or urban runoff in many of these subsegments. Therefore, any occurrence of low DO is almost certainly natural. As a result, a UAA for the area is necessary to reset the DO standard. A TMDL is unwarranted for these subsegments, and LDEQ takes exception to EPA generating TMDLs which are impossible to implement.

Response: EPA is required to generate these TMDLs based on the Modified Court Ordered 303(d) List and the requirements of Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7.

23. LDEQ's nutrient standard is based on total phosphorus (TP) and total nitrogen (TN), not total inorganic nitrogen (TIN). Since phosphorus is not the limiting constituent in Louisiana, the nutrient allocations must be in terms of TN and only TN.

Response: LDEQ's nutrient standard (LAC 33:IX.1113.B.8) does not specify that nitrogen to phosphorus ratios should be based on total nitrogen. However, EPA will consider this in future development of TMDLs in Louisiana.

In the coastal areas, the nitrogen to phosphorus ratio used was based on freshwater streams and is not applicable to brackish Gulf waters. LDEQ takes exception to the calculation of a TMDL based on TN/TP ratios derived from waterbodies other than the modeled waterbody. It is LDEQ's experience that the natural allowable TN/TP ratio is waterbody-specific and can vary dramatically between streams.

Response: EPA agrees that it would be ideal to have a large database of nitrogen to phosphorus ratios for each waterbody. However, because these subsegments have only limited nutrient data, the previously developed nitrogen to phosphorus ratio that was used in the draft reports is considered acceptable.

LDEQ has not adopted the EPA recommended ammonia criteria (1999) and takes exception to its use in this TMDL. In general, LDEQ does not accept EPA's use of national guidance for TMDL endpoints. The nationally recommended criteria do not consider regional or site-specific conditions or species and may be inappropriately over protective or under protective. No ammonia nitrogen toxicity has been demonstrated or documented in any of the waterbodies in these TMDLs. The general criteria (in particular, LAC 33:IX.1113.B.5) require state waters be free from the effects of toxic substances.

Response: Ammonia TMDLs were developed for two subsegments based on the requirements of Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7 and the fact that the Modified Court Ordered 303(d) List included ammonia as a suspected cause of impairment for those two subsegments. National guidance for ammonia toxicity was used in the absence of any numerical state water quality standards for ammonia.

24. The implicit margin-of-safety must not be quantified.

Response: The text of the reports has been revised to eliminate any quantification of the implicit margin of safety.

25. EXECUTIVE SUMMARIES: Add summary tables of the WLAs, LAs, and TMDLs showing the allocations and margins of safety.

Response: The summary tables of the WLAs, LAs, and TMDLs can be easily found in Section 5 of each report and do not need to be repeated in the executive summary.

26. Temperature Correction of Kinetics: A temperature correction factor was set for reaeration. It is LDEQ's standard practice to allow LAQUAL to calculate this factor. There is more guidance on this in the LAQUAL User's Manual.

Response: The temperature correction factor for reaeration was set to the value of 1.024 based on guidance in Section 3.3.8 of the LTP.

27. Water Quality Kinetics: The Louisiana reaeration equation was used on reaches that are outside the maximum depth that it was designed for. A more appropriate reaeration equation must be selected.

Response: The Louisiana equation yielded reaeration coefficients that appeared more reasonable than coefficients from other equations.

28. Water Quality standards and designated uses tables did not include the BAC (bacterial criteria) values.

Response: The water quality standards for bacteria are not relevant for these TMDLs.

29. The statement was made in the Initial Conditions paragraphs in several of the reports that temperature was specified because the temperature was not being simulated. The section then states, "For constituents not being simulated, the initial concentrations were set to zero ...". Initial conditions provide a starting point for the iterative solution of modeled constituents. They also provide values for constituents that are needed as input but are not being simulated.

Response: EPA appreciates this comment.

30. Several reports describe the benthic ammonia source rate as a calibration parameter; however a review of the data type 13 calibration input section indicates a value of zero for this parameter, in all reaches.

Response: The benthic ammonia source rate was used as a calibration parameter; the value of that parameter that provided the best fit between predicted and observed values was zero.

31. Calibration, and Projection, Data type 27: A salinity value was set to zero in the boundary conditions for both the calibration and the projection models in several of the TMDLs. With this value set to zero the model will automatically adjust the values of the lowest reach's elements to the value set in the boundary conditions. Since most of the models were one-reach, one-element models, the model automatically set the element salinity to zero, thus calculating an inaccurate value for the DO saturation.

Response: The only models where salinity was set to zero in the downstream boundary conditions were those models where salinity was not considered high enough to have a significant impact on DO saturation.

32. It is not LDEQ's standard procedure to use a zero headwater flow. You may not have input a headwater flow, but the model did. Without a headwater flow the model would have crashed and not run. The model's programming allows for a 0.0000001 cms flow rate when the modeler has not input a headwater flow.

Response: Only two simulations (calibrations for Spanish Lake and Big Constance Lake) used a zero headwater flow. For all practical purposes, 0.0000001 m3/sec is the same as zero flow.

33. Hydraulics and Dispersion: The use of constant widths and depths requires proper justification.

Response: The widths and depths were justified in Section 3 of each report.

34. Several reports state that algae were not simulated because algae did not appear to have significant impacts. What was the evidence for this statement? Did the contractor have any Chlorophyll a measurements?

Response: This statement was based on general knowledge of the Mermentau and Vermilion-Teche basins as well as a limited amount of diurnal DO data collected in these basins.

SPECIFIC COMMENTS FROM LDEQ FOR CHATLIN LAKE:

I. Chatlin Lake Canal/Bayou Du Lac and Bayou Des Glaisses Diversion Channel TMDLs for DO and Nutrients.pdf

1. 3.1 Model Setup, page 3-1, paragraph 1: A review of the pH and DO readings at the Bayou des Glaisses water quality site, indicates that it is likely that algae is affecting this waterbody.

Response: This paragraph has been revised.

2. 3.2 Calibration Period, page 3-2, paragraph 3: The reports stated that the critical conditions time frame was based on the measured field data from the two LDEQ water quality sites located on these subsegments. However the dates listed as critical, correlate only to the LDEQ site 0667's critical time frame. The LDEQ site 0667 in situ data strongly indicated a different time frame as critical. Also the data for 0667 indicates a high probability of algal activity, which could have skewed the DO readings, thus leading to an inaccurate determination of the critical time period.

Response: This calibration period was selected because during that time low DO conditions existed at both LDEQ sampling sites.

3. 3.4 Hydraulics and Dispersion, page 3-3, paragraph 1: How were the depth values estimated from the data sets given? The reviewer was unable to verify the given model inputs.

Response: Data, calculations, and plots for width and depth added to Appendix E.

4. 3.8 Headwater and Tributary Flow Rates, page 3-5, paragraph 1 & 2: The report states that a correction factor had to be applied to the flow rates to match the measured flow at the lower USGS gauging station. LDEQ questions the practice of a correction factor in this circumstance. The difference in the measured to estimated flow rates could have been caused by an error in the flow calculations based on the synoptic survey. Upon a review of the flow rate calculation spreadsheet, it was noted that the drogue velocity multiplied by the estimated stream cross-section was used to determine the estimated flow rate for the stream in question. It is the

USGS policy, which LDEQ has supported based on its own measured data, that the drogue thalweg velocity must be adjusted to obtain an average velocity across the cross-section. The adjustment must take into consideration the depth of the drogue and the drag of the banks to estimate a true average velocity. The measured drogue velocities by the contractor were not adjusted thus over estimating the flow rate measurements by approximately 25-30%.

Response: The statements in the report regarding use of a adjustment factor were incorrect and have been removed.

5. 4.3 Headwater and Tributary Inputs, page 4-3, paragraph 2: The 7Q10 headwater values are based on the flow rates downstream of a control structure. LDEQ questions the validity of a controlled flow being used to develop a relationship with drainage area to determine headwater flow conditions.

Response: In the description for USGS gage 07383500 in the Water Resources Data Louisiana report (USGS 1998) it is stated that the diversion channel receives overflow from the Red River when the floodgates are in operation. At all other times the gage receives only natural flow. Therefore diversions from the Red River would not be expected during low flow conditions and the 7Q10 calculation should not be affected by these diversion flows.

6. 5.1 DO TMDLs, page 5-1: Why do the "all point source loads" listed in the [Table2_3] spreadsheet not equal the given loads in Tables 5.1 and 5.2.

Response: Because the values in Tables 5.1 and 5.2 are the totals from the TABLE2_3.XLS file minus the MOS.

7. 5.4 Seasonal Variations, page 5-3: The report states "In addition, the models account for loadings that occur at higher flows by modeling SOD". Several other parameters should also be added to SOD, including resuspended CBOD and Organic Nitrogen.

Response: This statement has been revised to include resuspended CBOD and organic nitrogen.

GENERAL COMMENTS FROM LOUISIANA STATE UNIVERSITY (LSU) AG CENTER
(some of these comments may not apply to this report):

Through this letter the Louisiana State University AgCenter would like to submit official comments on TMDLs for dissolved oxygen and nutrients associated allocations for waterbodies in:

- Vermilion River Cutoff
- Bayou Chene

- Bayou Petite Anse
- Bayou Tigre
- Big Constance Lake and Mermentau Coastal Bays and Gulf Water
- Charenton Drainage and Navigation Canal and West Cote Blanche Bay
- Chatlin Lake Canal/Bayou Du Lac and Bayou Des Glaises Diversion Channel
- Dugas Canal
- Franklin Canal
- Freshwater Bayou Canal
- Irish Ditch/Big Bayou
- Lake Arthur, Grand Lake, and Gulf Intracoastal Waterway
- Lake Peigneur
- New Iberia Southern Drainage Canal
- Spanish Lake
- Tete Bayou
- Bayou Carron
- West Atchafalaya Basin Protection Levee Borrow Pit Canal

The number of different TMDLs sent out for comment at the same time may overwhelm the public's ability to comment. With only 30 days to prepare and submit comments it is impossible for a qualified faculty member to review the supporting data in depth and attend to his(her) official responsibilities. I realize that the agency is under time constraints on completing these, but I earnestly request that more time per proposed TMDL be given in the future.

We must make several other general comments and objections that apply to most of the proposed TMDLs. In many cases the data used to calibrate the models for the stream segments was collected in the fall of 2000 near the end of a three year drought. Historic low flows were often commented on in the text of the TMDL. Low flows result in a biased estimate of the natural ability of the stream to reaerate and cleanse itself of pollutants. Low flows also enable the benthic blanket to accumulate and remain in place undisturbed causing overstatement of the benthic oxygen demand and the SOD which were in many cases the primary oxygen demand loads in the stream. While it is true that the high flows that come from storm events carry more organic and sediment loads into the stream, the high flow rates also scour material from the bottoms and move it on to a final deposit at the stream terminus. It was thus that most of Louisiana and all of our coastal areas were built. Prolonged drought conditions do not allow this natural cleansing to occur. Thus it is our belief that the part of the oxygen demand load attributed to benthic and sediments is overstated and that new data must be collected during normal rainfall conditions and the models re-calibrated.

Response: The Louisiana water quality standards are applicable during all flow conditions greater than the 7Q10. Because 7Q10 flow is frequently the most critical condition for maintaining the DO standard, it is desirable to collect field data for model calibration during times when the hydrology is as close as possible to 7Q10 conditions. It is believed that the flow conditions for these waterbodies may have been near 7Q10 conditions, but probably not lower than 7Q10 flows. Therefore, the summer-fall 1998 data is desirable for model calibration.

In far too many of the proposed TMDLs the phrase *"an intensive field survey was not conducted for the study area due to schedule and budget limitations"* was found. If municipalities, agriculture, and business

entities are to be asked to make large commitments of funds, time and effort to resolve our water quality problems they deserve to have the benefit of a serious study of the problem. We request that all of the proposed TMDLs that contain this statement have this problem corrected and that TMDLs be prepared based on complete studies.

Response: There is no requirement for collecting a certain amount of data to make a TMDL valid. If additional data are collected in the future by LDEQ, other agencies, or local stakeholders, then those data can be evaluated at the time and the implementation of the TMDL can be altered as necessary. As outlined in the 1991 EPA document titled "Guidance for Water Quality-Based Decisions: The TMDL Process", developing and implementing TMDLs is a process and not a one-time event.

In several of the proposed TMDLs data was used that is 9 or 10 years old from studies on point source discharges. While the data is probably high quality it assumes that no change in the plant or its load have occurred in the last decade. This assumption may not be defensible. In the TMDLs where a treatment plant was included in the model the margin of error was calculated by using 125% of the design capacity. This assumes a plant will perform at the same level when it is operated in excess of its design load. This assumption is also questionable.

Response: For several subsegments, old data sets were used for calibration because they provided more extensive data than newer data sets. However, all of the projection runs simulated point source discharges based on the most recent information available. Simulating point source discharges at 125% of design flow is simply a way of incorporating an explicit margin of safety and does not assume that the facility can actually treat that much wastewater.

The standard for dissolved oxygen (DO) was held at 5 mg/L in some streams on a year round basis, even if it received or discharged into a stream with 5 mg/L winter and 2 or 3 mg/l summer standards. Other streams had a year DO oxygen standard of 4 mg/L. We strongly suggest that a review be made of the DO standards for all of the streams in south Louisiana that are shallow, sluggish, and subject to tidal influence and that uniform standards be set. In view of the remarks that achieving a DO of 5 mg/L was impossible in some of the streams that had little loading from human activities, we believe that the summer standard of 2 mg/L is much more applicable to these streams.

Response: The TMDLs are required to be developed for the existing DO standard, which is 5 mg/L year round for many of these subsegments. If the DO standard is revised in the future for any of these subsegments, the TMDL and implementation can be altered as necessary as part of the TMDL process.

Many of these TMDLs were drafted by an out of state contractor and do not appear to be as well researched as those drafted by LDEQ. Very little data was included in the contractor drafted TMDLs summaries as compared to the ones prepared by or in conjunction with LDEQ. Additionally, the bulk of the text appeared to be standard wording in all documents with short relevant inserts. We would request that if outside contractors be used in future TMDL assessments that they be held to the same standard of information

inclusion that LDEQ provides. Stream diagrams and maps are often needed when reviewing descriptive text on stream location, tributary insert, and exact location.

Response: These TMDLs contain all the required components of a TMDL and the level of detail is considered acceptable. Because these TMDLs could not be funded at the same level as most of LDEQ's DO TMDLs, the analysis and documentation was not as extensive as most of LDEQ's DO TMDLs. However, some of the information that was mentioned in the comment (stream diagrams and maps) was included in the reports, but they were placed in the appendices (which were available from EPA upon request).